in Athni, and twelve in Parasgad. The eastern sub-divisions, Athni, Gokák, and Parasgad, are worst off for water-works. It is these parts of the district which generally suffer most severely from a partial or a total failure of rain. Of the 1055 water-works, 561 are permanent, watering 9215 acres assessed at £3277 (Rs. 32,770), and 494 are temporary, watering 6785 acres assessed at £1991 (Rs. 19,910). Of the water-works, seventy-four water over fifty acres, 205 water between fifty and twenty acres, and 776 water less than twenty acres. Of the whole number of water-works 663 are reservoirs, 146 are watercourses, and 246 are river and stream dips. Of these three classes of water-works the reservoirs are the most important. Most of the larger reservoirs are in such a state that they cannot hold more than one season's supply, and many, however heavy the rainfall, are dry before the end of the next hot season. Of late, especially during the 1876-77 famine, much has been done by Irrigation engineers to improve the reservoirs. Of the improved reservoirs the chief is the Gaddekeri lake at Mugutkhán-Hubli about fifteen miles south-east of Belgaum. The Gaddekeri lake has an area of 126 acres and a maximum depth of five feet. The catchment basin measures 4·62 square miles and the average rainfall is 26·33 inches. Before the 1876 famine it was intended to raise the water surface 2·38 feet, thereby increasing the gross storage from 14½ to 27½ millions of cubic feet, and to build two waste weirs one at each end of the dam. The dam was begun as a relief work in 1877 and completed in 1878. The estimated cost of the proposed improvements was £1616 (Rs. 16,160); the expenditure on famine relief labour up to the end of 1877-78 amounted to £831 14*s.* (Rs. 8317); and the value of the work done, at normal rates, was £798 6*s.* (Rs. 7983). Since 1877, at a cost of £1130 (Rs. 11,300), the water surface as originally intended has been raised 2·38 feet, thus increasing the storage by thirteen millions of cubic feet. The improved lake will furnish a supply for 450 acres. On lands watered from the Gaddekeri lake a special acre cess of 10*s.* (Rs. 5) is levied for rice lands, and of £1 (Rs. 10) for garden lands. The rates are levied not according to the fitness of the land for rice or for garden crops, but according to the crop for which the water is actually used.

Three water-drawing appliances are in use, *mots* or leather-bags, *páts* or channels, and *dols* or bamboo baskets. The *mot* is a large leather-bag with two holes. One hole which is nearly the entire breadth of the bag, is kept at full stretch by a square or round frame with cross pieces, the other hole is narrow and pipe-like. A stout rope fixed to the bars of the great hole, is passed over a roller supported by side posts above the level of the reservoir, and is fastened to the yoke of the bullocks who draw up the bag. A smaller rope, fastened to the pipe-like hole of the bag, passes over a second roller below the first roller, and is fixed to the greater rope near the yoke. An inclined plane is prepared, down which the bullocks walk and draw up the full bag till at the top it spills into a masonry cistern. Then, while the empty bag falls into the water and fills, the bullocks back to the top of the slope and again walk down the slope dragging up another bagful. From the cistern into which the bag spills channels carry the water all over the land. Leather-bags are also used in drawing water

Chapter IV. Agriculture. Irrigation.

from holes dug near rivers and streams. Channels or *páts* are built to carry off water from rivers, streams, and reservoirs. The channels are supplied with water without the aid of bags from streams or other water-courses where water can be dammed to the proper level and turned into the channel. When the water in a stream or reservoir is below the level of the channel or *pát* the water is raised by a basket or *dol*, a three-cornered bamboo basket large enough to hold an ordinary jar of water. At two corners of the basket ropes are tied. The end of each rope is caught by a strong man, for the work is heavy, and they dip the basket into the water, and when it is full, lift it up and toss into the channel as much water as remains in the basket. In some places two to six baskets are worked at the same time.

Wells.

Of 11,818 wells used for watering, 3374 are step-wells and 8444 are dip wells. Of the 11,818 wells, 4214, of which 948 are step-wells and 3266 are dip-wells, are in Chikodi; 3073, of which 136 are step-wells and 2937 are dip-wells, are in Belgaum; 1832, of which 1191 are step-wells and 641 are dip-wells, are in Athni; 1028, of which 533 are step-wells and 495 are dip-wells, are in Gokák; 905, of which 337 are step-wells and 568 are dip-wells, are in Sampgaon; and 766, of which 229 are step-wells and 537 are dip-wells, are in Parasgad. In Khánápur no wells are used for watering. Water is always drawn from wells by the leather-bag or *mot*. Water is found near the surface in a small area close to the Nágzari springs in the Belgaum Cantonment and in the Chikodi villages along the Krishna. In other parts of the district, especially in Parasgad, wells have sometimes to be sunk as much as a hundred and fifty feet. The depth of wells varies from five to sixty feet in Belgaum, from twelve to forty feet in Sampgaon, from ten to fifteen feet in Chikodi, from twenty to 150 feet in Parasgad, from twenty-five to fifty feet in Gokák, and from thirty to fifty feet in Athni. The cost of building a step-well varies from £50 to £400 (Rs. 500-4000), and of building a dip-well from £10 to £200 (Rs. 100-2000). At a good well four water-bags can be worked. With a sufficient supply of water one bag can water five acres, the area largely depending on the soil and the crop. In ordinary cases one bag waters from one-fourth of an acre to an acre in a day. The crop is watered by channels carried from the top of the well, where the bag is emptied, to the fields. The channels are made so as to allow the course of the water to be changed every two or three yards so that each row of crops may have an equal supply. The crops irrigated are rice, sugarcane, potatoes, onions, garlic, cabbage, and other vegetables, plantain trees, groundnuts, chillies, sweet potatoes, and turmeric. The husbandmen value irrigation, but few are able to bear the expense of sinking wells and building channels. Within the last five years the returns show a gradual fall in the area of irrigated garden land. In 1878-79 the garden area under irrigation was 17,900 acres, in 1879-80 it fell to 16,222 acres, in 1880-81 to 16,520, and in 1881-82 to 15,870 acres. This decline in the irrigated area is believed to be due to the fact that the lands are mortgaged to moneylenders and that as the mortgager may any day be foreclosed, the holders are unwilling to be at the expense of irrigating them.

A great water-work called the Gokák canal is at present being made at the expense of Imperial revenues. A project for a large canal with headworks on the Ghatprabha above the Gokák falls was first brought to notice in 1852 by Captain, subsequently Sir George, Wingate. A preliminary survey, made by Colonel, now Lieutenant-General, Walter Scott, R.E., showed remarkable facilities for leading a canal from a point about two miles above the falls to water the tract lying between the Ghatprabha and the Krishna and comprising portions of Gokák in Belgaum and Bágalkot in Bijápur and of the Mudhol and Jamkhandi states. The river has a sheer descent of about 170 feet at the lowest part, and at the spot chosen for the canal-head the total command is about 220 feet. Colonel Scott showed that, by cutting through a ridge of hills on the left of the valley, the canal could at once be brought out with complete command of the country beyond. From 1865 to 1867 the project was surveyed in detail by Lieutenant now Major Smith R. E., under the orders of Colonel now Lieutenant-General Fife R. E. It comprised a total length of 162 miles of main canal at an estimated cost of £485,000 (Rs. 48,50,000). Owing to the difficulties of carrying the canal through the native states the larger project was placed in abeyance, and a fresh scheme was drawn up for a definite project for watering only the lands of Gokák in Belgaum. In 1868 the project was submitted. It comprised fifty miles of main canal commanding an area of 135 square miles. The cost for works only was estimated at £150,000 (Rs. 15,00,000) and the return on expenditure at six and a quarter to six and three quarters per cent. The Government of India did not consider the scheme sufficiently satisfactory to admit of its being sanctioned from loan funds, and suggested further revision of the designs and estimates. This revision was in progress, when, in 1871, under orders from the Government of India, all large irrigation projects in the Bombay Presidency were placed in abeyance. In 1873 the revision of the scheme ordered in 1869 was carried out by Major now Colonel C. B. F. Penny R. E., and plans and estimates were made ready for an immediate beginning of the work. According to Major Penny's plan a masonry weir was to be thrown across the Ghatprabha at a site about two and a half miles above the falls. The great natural height thus obtained would allow the canal to be led from the left bank at right angles to the course of the river. The canal would run north for about nine miles where it would cross the Pamaldini streamlet by an aqueduct of thirteen arches each of thirty feet span. From this point the canal would take an easterly course generally parallel to the river and from six to eight miles from it. The canal would tail at the village of Shivápur forty miles from the head. A branch about twelve miles long would be taken off at the third mile. The scheme included provision for complete regulation and distribution. The canal was designed to carry 430 cubic feet a second at the head and to command a total arable area of 77,319 acres or 121 square miles at an estimated cost of £97,500 (Rs. 9,75,000). During the 1876 famine the Gokák canal project was brought forward as a means of usefully employing the

Chapter IV. Agriculture.

Irrigation. *Gokak Canal.*

people. Between the end of 1876 and December 1877 the earth-works on a length of nine miles of canal, beyond the deep cutting in the first 3½ miles, were partially completed. The highest number of people employed was 11,946, the outlay was £17,788 (Rs. 1,77,880) on wages and charitable relief, and the value of the work done was £7646 (Rs. 76,460). In October 1877 a gang of about 600 convicts was employed on the heavy cuttings through the ridges in the first 3½ miles of the canal. The works during the famine were in the charge of Mr. H. G. Palliser, the Executive Engineer for Irrigation in Belgaum and Dhárwár, acting under the orders of Colonel now Major-General Merriman R. E., then Chief Engineer for Irrigation. In December 1877 the Mudhol Chief desired to have the Gokák canal extended through his territory. Steps were taken to ascertain how far it was possible to modify the designs so as to allow the canal to debouch on to the watershed between the Krishna and the Ghatprabha near the village of Mantar about 110 miles from the head works, from which point branches could be thrown to command the Bágalkot sub-division of Bijápur on both sides of the water-shed. In April 1879, Sir Richard Temple, then Governor of Bombay, visited the country intended to be cut by the canal. As he considered it necessary as far as possible to utilize the work already done by famine and convict labour, fresh plans and estimates were made. The part of the new project sanctioned in March 1882 comprised the weir and headworks on the Ghatprabha four miles above Gokák with two and a half miles of main canal and a branch eleven miles long to the village of Vaddarhatti eight miles north-east of Gokák. This section which is nearly completed (February 1884) commands the country between the Ghatprabha and its tributary the Pamaldini which includes about 25,200 acres of good arable land. The cost is estimated at at £45,800 (Rs. 4,58,000) including all charges.[1] The extent to which the scheme, as sketched out by Sir Richard Temple, may eventually be expanded, comprises a length of about 180 miles of main canal with very extensive storage works to supplement the natural supply of water in the river during the dry season. The total area that would thus be commanded is about 625 square miles, of which about 375 square miles are in British territory and the remainder in the neighbouring native states. The entire cost of such a scheme is estimated at £1,400,000 (Rs. 1,40,00,000) and the return at four and a half per cent. The canal would have a discharging capacity at head of 1200 cubic feet a second and the storage works would impound 10,580 million cubic feet.[2]

Manure.

Pure black soil does not require manure, but the yield from red and sandy soils depends on the amount of manure they receive. Husbandmen value manure highly. Each landholder has his manure-pit into which every morning house sweepings, ashes, and cattle litter are thrown. To this all kinds of rubbish and decayed vegetable

1 The works have been designed and carried out by Mr. R. B. Joyner, C. E., Executive Engineer for Irrigation in Belgaum, Dhárwár, and Bijápur.

2 Fuller details are given by Mr. R. B. Joyner under Gokák in Places of Interest.

Manure.

matter and fallen leaves are added. By the time it is ready for carting the rubbish and litter have decayed to powder which is generally spread in the fields from about the middle of March till the end of May between the thunderstorms which are commonly known as the mango showers. The supply from the manure-pit is supplemented by gathering into heaps in the field and burning roots of the former crop, dried weeds, and rubbish. In rare cases, as soon as the first rain falls, a farmer plants some quick-growing crop and ploughs it green into the land as manure for the main crop. Bone manure is not used. The supply of manure would be much greater if the bulk of the cattle dung was not burnt as fuel. The husbandman's belief in liberal manuring is shown by the high price house-sweepings, litter, and other garbage command in all large towns and villages. To manure an acre of land ten to fifteen cartloads are required, each cartload costing 1*s.* to 2*s.* (8 *as.* - Re. 1).

Rotation.

Millet is the least exhausting and cotton is the most exhausting crop. In places where land is scarce, husbandmen frequently raise red millet for many years from the same red soil fields without change; and on rich black soil there is no more profitable course than to grow an unbroken succession of crops of white millet. It is believed that yearly crops of white millet might be raised for a century without wearing out the land. As a rule, cotton and other cold-weather or *hingári* crops are raised in alternation with each other. Cotton, particularly, does not thrive two successive years on the same ground; it must be followed by white millet or by wheat. Among the various rain or *mungári* crops, when other considerations admit of such a course, some variety, though not a systematic circle of changes, is observed.

Wood-ash Tillage.

Formerly large tracts in the more open parts of the forests were cultivated by brushwood-burning or *kumri*. The chief brushwood burners were Maráthás. In the cold season, on a space of ground, commonly on a hill-side, the Maráthás cut down the bushes and the lower branches of the larger trees. They let the brushwood and dead branches dry during the hot season and burnt them before the rains set in. The effects of the fire pass three to six inches below the surface. In some places, without touching the surface with a tool, on the fall of the first south-west rain, the seed is sown in the ashes. In other places before the seed is sown the ground is ploughed or hoed by the hand. *Rági* Eleusine corocana, and in the next year *sáva* Panicum miliare occasionally mixed with pulse, are the grains raised by bush-burning. After the second year's crop the plot is considered exhausted and is left. After ten or twelve years, when the ground is again clothed with bushes and its surface regains something of a turfy texture, the process is repeated. This form of tillage, because of the destruction it caused to the brushwood, was for many years very greatly restricted. The restriction pressed heavily on the hill-people. They found no other employment and yearly made long journeys to Sávantvádi and Goa where wood-ash tillage was allowed. Under these circumstances, subject to certain conditions, arrangements have been made for allotting tracts of bush-land for wood-ash tillage.